Teachers' Questions: Can they support understanding and higher-level thinking?

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Introduction

The potential of questioning to support learning is widely recognised. When teachers ask questions the assumption is that they (the questions) do something useful and, what is more, the more questions asked, the more good they do. Perhaps this is why research tells us that teachers ask a lot of questions during their lessons (e.g. Cotton, 1989; Newton, L., 1996; van Lier, 1998). Sometimes lessons can appear to be nothing but questions. Mohr (1998) noted teachers asking about 100 questions per hour and Brualdi (1998) recorded 300-400 questions per teacher per day. Yet Walberg (1984) placed questioning only 17th in a list of 35 instructional strategies for effectiveness. Similarly, Hattie (2009), in his meta-analyses of research relating to achievement, found questioning to be one of the mid-range strategies for effectiveness, with a *d* value of 0.46[2]. Why is this the case? Perhaps the answer lies not with the quantity of questions but with their nature and purpose.

Gadamer (1993: 375) suggests *'Questioning opens up possibilities of meaning'.* Are teachers asking questions that do this? Research indicates that they use questions for a variety of purposes, from assessment and monitoring of the learning to organising and managing the learners. However in terms of supporting rich learning experiences, teachers' questions generally lack variety (Newton, L., 1996; Brualdi, 1998). The changing needs of learning situations can be ignored. Hattie (2009: 182) sums up the problem as relating to:

> *'... the conceptions of teaching and learning held by many teachers – that is, their role is to impart knowledge and information about a subject, and student learning is the acquisition of this information through processes of repetition, memorization, and recall.'*

He advocates higher-order questions to enhance understanding. Questioning is a strategy that has the potential to support students of all ages as they relate facts, construct meanings, satisfy their curiosity, make decisions, solve problems and build and change their mental models of the world in which they live. However, it is not so much the number of questions asked by the teacher that matters but what they do for the learner. Half a dozen, well-posed questions that focus on particular thinking needs at crucial times are likely to be of more benefit than a hundred questions, scattered like confetti and demanding only the quick recall of facts. Such questions cannot, however,

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[2] Hattie (2009:7), in his meta-analyses, says that '... an effect size provides a common expression of the magnitude of study outcomes for many types of outcome variables, such as school achievement. An effect size of $d = 1.0$ indicates an increase of one standard deviation on the outcome ... [1 s.d.] increase is typically associated with advancing children's achievement by two to three years ... [or] improving the rate of learning by 50%.'.

always be conjured up from thin air but are likely to benefit from forethought and planning.

Following a brief review of the nature and role of teachers' questions in the classroom I will present some ideas to do with questioning for the particular purpose of encouraging understanding and higher-level thinking. Looking at questions through taxonomies risks an either/or view of how to question when, it is argued here, questions should be *focused* to reflect the immediate needs of the situation and support mental processes on the way to better thinking.

A Brief History of Questioning

The use of questioning as a strategy has a long history, spanning not just centuries but millennia (McNamara, 1981). Interrogation in one form of another probably existed long before Socrates in Ancient Greece but Socratic questioning is one of the oft-cited early illustrations of the strategy in use in educational contexts (Dillon, 1990). Socrates was intent on having people think, understand and justify their assertions. This was not something that everyone liked or found comfortable but, presumably, Socrates thought it did some good. In his own words, *'A question is a midwife which brings forth ideas from the mind.'* (Socrates, quoted by Austin, 1949: 194). He is said to have believed participants in a dialogue are equal partners, either of whom can assume the roles of interrogator and respondent. When his students expressed an opinion, Socrates used closed questioning to invite them to exhibit their ideas, thus exposing the extent of their knowledge and understanding. Then he would challenge their views by introducing new data or ideas or pointing out their logical inconsistencies. Thus Socrates' own use of questions was much more as a tactic to manage answers than as a means to stimulate student-centred enquiry.

In England, Aelfric of Eynsham in the Middle Ages wrote study aids in which pupils were asked questions about a range of characters like the ploughman, the hunter and the fisherman (Evans, 1978). In the sixteenth century Francis Bacon stressed the educational value of questions, stating:

> *'He that questioneth much shall learn much, and content much, but especially if he apply his questions to the skill of the person whom he asketh, for he shall give them occasion to please themselves in speaking and himself shall continually gather knowledge...'*
>
> (quoted by Morgan & Saxton, 1991: ii)

Moving forward to the eighteenth century, an extract from the diary of a country schoolmaster in 1784 tells us that:

> *'[Dec]16 Thursday Snow this afternoon. Evening was reading the Roman History by question and answer. Have read about half of it, and recommend on it, to be read by school boys...'* (Coates, 1784:37)

This reflects the use of the catechism approach which was dominant in schools in the late eighteenth and nineteenth centuries. This approach (named for the rote learning of

the Catechism in churches) involves a pattern of teacher-question and pupil-recitation of factual information acquired by rote learning. Gosden (1960: 118) quotes from C. Irving's book, *A Catechism of Botany* (1821), which exemplifies this approach. The teacher (T) is discussing plants and the pupil (P) is responding with what he has learned by rote.

> *T. What plants are of the second class?*
> *P. To the class Diandria belong all the plants which have two stamens in each flower.*
> *T. What native plants are there of this class?*
> *P. The privet, butterwort, meadow-sage, brook-lime speedwell, and others are common in Britain; and the last of these may be chosen to illustrate the class.*

By the end of the 19th and early 20th century questioning for rote learning of facts and ideas can still be seen in the object lessons of those times.

> *There were 'object' lessons now and then - without any objects but with white chalk drawings on the blackboard - an oil-lamp, or a vulture, or a diamond might be the subject. Once there was a lesson on a strange animal called a quad - ru - ped -- cloven footed, a chewer of the cud; her house was called a byre (but in Tysoe it was not); her skin was made into shoes and from her udder came milk. It burst upon Joseph that this was one of the creatures he would milk after school, part of Henry Beasley's herd. He would milk three or four cows...* (Ashby, 1961: 18)

The problem with this approach is that, as can be seen above, it can be very easy to slip into the habit of drumming in the facts and neglecting understanding. Facts are important, without them there is nothing to understand, but understanding is a powerful way of knowing and so is important. For understanding to occur, however, the learners have to think.

Nor is this emphasis on questioning only confined to students in schools. It was apparent at all levels of education. For example, Brewer (1894) described the focus on questioning in the early examination procedures at the University of Cambridge:

> *'... it was customary, at the beginning of the January term, to hold `Acts', and the candidates for the Bachelor's degree were called `Questionists'. They were examined by a moderator, and afterwards the fathers of other colleges "questioned" them for three hours... It was held altogether in Latin, and the words of dismissal uttered by the Regius Professor indicated what class you would be placed in...'* (Brewer's Dictionary, 1894: 1027-8)

The Socratic approach also proved to be long-lasting, surviving through to more recent times where it can still be seen in many university oral examination systems for higher degrees as the familiar *Viva Voce*, the means by which the breadth and depth of knowledge of the candidate's thesis is tested.

In the twentieth century, questioning has been increasingly the subject of more formal research. It is not, and has never been, the sole prerogative of the discipline of education. Dillon (1982) surveyed the literature on questioning in twelve different fields of thought. The fields had different emphases and used different approaches. He found a diverse range of theories and practices, each standing in relative isolation and yet he suggested that they had much to contribute to one another's concerns. Despite his meta-analysis, Dillon was unable to construct a reliable working definition of questioning, as he found no single set of characteristics common to all types and functions question. He states:

> *'Of all the literatures on questioning, that in education is the oldest and largest, and is probably the most encompassing of the many facets of questioning.'* (Dillon, 1982: 152)

This wealth of literature on questioning in education has been regularly reviewed (for example, Sanders, 1966; Gall, 1970; Dillon, 1982; Dillon, 1988; Morgan & Saxton, 1991; Newton, 1996; Newton & Newton, 2000; Chin, 2006). All sources agree that questioning as a strategy is extensively used in all aspects of teaching and learning - in textbooks and work cards, in assessment tasks and, most commonly, in various aspects of classroom discourse. Such studies have also generated a variety of systems or taxonomies for sorting and classifying questions into categories. Much of this work has been North American in origin and, in the educational context, has tended to focus on older school pupils and college students.

Question Asking for a Purpose

Much of the early research into questioning was not of great practical help to teachers. It did, however show that, as teachers, we all differ enormously in how we use questions but the variety of questions tends to be small so that most of the time is spent managing the class or asking for the recall of facts and rehearsing answers. For instance, Brown & Wragg (1993) found that the questions of primary teachers in the south west of England comprised some 10% of a day's interaction. They analysed over 1,000 questions asked by these teachers. Most (92%) of the questions were of a management and control nature. Of those to do with the lesson content, most were of the closed or recall of factual information type. There were far fewer (8%) open or more demanding questions that went beyond the recall of facts. They suggested that:

> *... teachers do not necessarily prepare such questions, but somehow expect them to arise spontaneously. It may be that if we want to ask questions to get children to think, then we've got to think ourselves about the questions we are going to ask them.* (p. 14)

Fifty primary teachers in north east England, when asked about the questions they use, all claimed to use a full range of questions in their lessons, including those that encourage higher level thinking (Newton, 1996). When 26 of them were then observed teaching a science lesson they did indeed use a lot of questions. However, the majority (nearly half) were descriptive (*What ...? Where ...?When ...?*) or procedural (*How...? Who...? Which...?).* The teachers rarely went beyond description and recall, seldom

pushing the children to explain (*Why...?*), predict (*What if ...?*) or apply their existing ideas in new contexts (*Could you ...? Does ...?*). Surrogates (workcard schemes and books designed for student use) were also examined for the types of questions asked, with very similar results.

The point is that teachers, and the authors of books and teaching schemes, may ask a lot of questions but not always about the lesson in hand or necessarily to the best effect. They do not ask questions which promote understanding and higher level thinking such as analysis and synthesis or creative and critical thinking. Teachers are not, of course, equally confident across all subjects they may be asked to teach, especially in the primary or elementary stages. Where broad, underlying subject knowledge is not strong, the teacher may find it easier to stick to facts. They may even think that it is facts that count as understanding in that subject. Yet Newton & Newton (2000) found that in primary schools there are teachers without an A-level or higher qualification in science who do ask for more than facts and there are also those with science degrees who seem to ignore everything other than facts. At the same time, teachers may see their main task as the transmission of ready-made information, not the promotion of active participation and learning with understanding (Rodriquez and Kies, 1998), what Elder and Paul (1998) described as burying thinking under tons of information. But, by asking closed questions (those that lead to a right answer), the teacher diverts the pupils' thinking from wider problem solving into a search for that 'right' answers'. In effect, the cognitive hard work is being done by the teacher, not by the pupils. Related to the cognitive demand of tasks and questions is the work of Neumann and Mahler (1989). They investigated the cognitive congruence in questioning (the degree of cognitive match between the questions asked by the teacher and the pupils' answers). They found a mismatch in that the questions were not stretching the pupils' thinking abilities. The teachers' questions functioned at the task level (that is, management, procedural, factual recall) not at the cognitive level (requiring higher order thinking skills).

There is no doubt that the questions teachers ask control communication and hence influence the learning (Gall, 1970; Dillon, 1982; Newton, 1996; Rodriquez and Kies, 1998; Shaunessy, 2000). Closed or factual questions enable teachers to retain control. They ensure progression on the teacher's terms, the role of the learners being that of a respondent in the communication slots allowed by the teacher. Such control restricts the cognitive freedom of the learner. More demanding questions may reduce the teacher's control of the content and direction of the lesson.

Research has shown that children's thinking and problem solving abilities improve when teachers use higher level questions (e.g. Blosser, 1973; Andre, 1979; Redfield & Rousseau, 1981; Koufetta & Scarfe, 2000). These questions are usually considered to be those that ask for higher levels of cognition as defined in various taxonomies, such as that of Bloom (1956) or Anderson and Krathwohl (2001). The questions require mental actions such as evaluation or synthesis of information and

knowledge. More recent work found that *What if...?* and *Why…?* questions stimulated creative and critical thinking which, if followed by more questions, encouraged the development of ideas and the construction of understanding (Fredericks, 1991; Kazemi, 1998). These findings were also confirmed by Newton (1996) in a study of teachers' questioning in primary science lessons. Willig (1990) also suggests that skilful questioning lies at the heart of a cognitive conflict strategy, making children reflect upon their ideas and their reasons for holding those ideas. Whatever the potential of higher level questioning, however, it is academic if they are often absent in the classroom.

A problem with this is the under-pinning assumption that higher-level questions elicit higher cognitive level answers. Even when questions relating to the higher levels of taxonomies are asked, Dillon (1982) found that higher order responses do not automatically follow. Any question narrows the options open to the respondent, limiting the field of thought to that intended and expected by the questioner. The degree of restriction depends on the type of question asked, the degree to which the questioner and learner share common knowledge and experiences and the extent to which the questioner is in a real position to evaluate the answer. This emphasises the importance of contexts and shared meanings for question asking and answering. Researchers have tried to assess the cognitive level of the questions or have focussed on the interactional, as well as cognitive, effects of open, half-open and closed questions (Call, 2000). There have been numerous attempts to produce classification systems or taxonomies which teachers might use yet they seem to be unaware of such taxonomies or do not use them (Dillon, 1990). Many of these systems suggest a hierarchy from lower level/order questions to a higher level/order. Generally, the former are concerned with simple factual recall or basal comprehension, while the latter involve understanding, meaning making, reasoning and thinking.

Focused questions

Tying questioning tightly to particular levels in taxonomies is not always of great practical benefit. Asking questions at any particular taxonomic level without regard for what is going on in the learner's mind is not likely to be productive. It is not a matter of *one* kind of question being better than another but of recognising *which* kind is needed and knowing how to use it to good effect. What is the right kind of question for the right purpose? This is focused questioning.

Martens (1999) talked about productive questions, those that help teachers to bridge between task and learner. The focus of these productive questions, according to Martens, is on attention-fixing; measuring and counting; comparing; action-generating; problem-posing; and, reasoning. I prefer to call them focused questions because this indicates better that they are tailored to the particular needs of the learning situation, and these vary from learner to learner and lesson to lesson. These evolving learning situations might include episodes of, for instance:

- tuning children's attention to the task in hand;

- eliciting prior knowledge;
- developing or supplementing that knowledge;
- developing a grasp of the new situation;
- highlighting significant relationships;
- consolidating learning;
- articulating ideas;
- developing and using learning;
- applying ideas in new contexts; and,
- deepening and widening learning.

What is productive in one of these episodes may be different to what is productive in another but the type of question is not always a useful guide. For example, *How...?* as a process (as in, *How did you measure the distance?*) cannot be distinguished from *How...?* as a fact or quantity (as in, *How far is it?*). However, when the focus of the question is considered, the outcome changes. *What was the name of …?* and *How did we …?* questions function to elicit prior knowledge and understanding, the former of factual information learned and the latter of procedures. *What happens if …?* and *How might we…?* questions extend and apply knowledge and understandings gained from prior and current experiences. All are useful productive questions but are stronger in their use if focused on particular stages in a lesson. Recall of prior experiences would work well at the beginning of the lesson to set the scene for new experiences. Extension and application questions focus attention on the new experiences and force learners to connect ideas and construct new understandings.

The process of constructing understanding and laying the foundations for productive thinking can be supported by the teacher's strategic use of focused questions. The same kinds of questions can be used for different purposes in the different steps.

[1] **Scene setting / relevance:** ask questions to engage interest and make relevance explicit: *Who knows ...? Have you ever ...? Remember when we ...? What did we do when ...? What happened if ...?*
[2] **Specific prior knowledge ready for inferencing:** ask questions which elicit or ensure the learners have the necessary prior knowledge to work with; *Who can tell me why ...? What is a ...? Why does a ...? What do you mean by ...? How does ...? What happened when ...? How did we ...? When/where else might ...?*
[3] **Setting expectations / guiding and focusing:** let the learners know what they are expected to do mentally as well as physically and use guiding questions to help the learners to focus on what is relevant to the task/topic in hand; *Is it ...? Why has / why hasn't ...? What happens when ...? Why is that ...? How can you ...? Does it matter if ...?*
[4] **Use the learning in new situations:** encourage the learners to explain and predict, and apply their ideas in new contexts through problem solving; *What will happen if we ...? What if we use ...? Why is ...? Which will ...? Can you explain ...? What would ...? Why is it important to ...?*

Such a focusing of questions is intended to stimulate more precisely the active thinking that is needed at that point. Supporting learning through questioning, therefore, involves a sequence of questions, each helping the child over a particular mental obstacle. Of course, not every topic will present every obstacle so the pattern of focused questioning cannot be a rigid one. The focus on the use of questions by teachers to develop students' thinking was also explored by Chin (2006). From her analysis of the dynamics of the interactive relationship with 11-12 year olds in science classroom, she identified a number of enabling strategies relating to teacher questioning and feedback:

- avoidance of explicit evaluation or put-downs;
- acknowledgement of the students' contributions;
- re-statement of student responses; and,
- ability to pose follow-up questions that build on the earlier responses and stimulate cognitive processing.

She also noted that all strategies appeared to promote productive talk rather than mere rote recall responses. She advocates the need for teachers to *'position themselves as enablers of talk for thinking'* through the deliberate use of *'... meaningfully related questions that stimulate students to tap into higher-order thinking process"* (Chin, 2006: 1343-4).

The beginning of this productive, higher-order thinking is understanding. A traditional view of understanding is one of *"How much?"* - an additive view. New learning (facts, ideas, information, ...) is added on to what is already known. More contemporary views now see understanding as the construction of mental models of situations or experiences, with new ideas being related to each other and integrated into the existing mental structures to build something new (Newton, D., 2012). While a good memory can provide the answer to many questions, this doesn't necessarily reflect understanding. For example, the question, *"Which substance has the chemical symbol H_2O?"* will probably generate the immediate answer, *"Water."* But the answer does not tell us what the respondent understands about that substance. Does s/he understand elements and compounds or the properties of water? Facts are important. Knowing facts can be very useful and enable economical responses. Think of names and dates, symbols and signs, mnemonics - these are all useful for thinking. But it is the relationship between facts and understanding that is important. In the classroom, facts and understanding work in combination.

Lustick (2010) suggests that using quality focused questions enables learners to engage in authentic inquiry about relevant phenomena, benefitting both teachers and students by fostering curiosity and enriching understanding of content. This is inherently inquiry-based learning, problem solving and creative thinking (Newton, L., 2012). So how do we encourage teachers to do this?

Developing Teachers as Skilful Questioners

Most children know the question and answer game from a very early age. Taylor and Taylor (1990) noted that very young children can distinguish questions from non-questions, and *yes-no* questions from *Wh*-questions, relying on intonation, the presence of key words and sentence structure. Even 2-year-olds are able to do so, although not always responding appropriately. Berninger and Garvey (1981) found that yes-no questions evoked relevant responses from all the 3-year olds tested, but certain *wh*-questions evoked irrelevant responses from them. Some *what* and *where* questions were easily answered by them using pointing words, such as *that* and *there*, and often questions were answered with offers of demonstration, such as, *'I'll show you.'* However, *why* questions require answers that involve formulating cause and effect. Berninger and Garvey found younger children unable to handle these. By the age of 4 years, Wells (1986) found most children studied were enthusiastic question askers, although many parents found difficulty answering appropriately. Children themselves are no obstacle to the strategy. The problem is in defining skilful questioning and helping teachers to question skilfully.

Willig (1990) wrote that what counts is not so much the kind of questions asked but rather the strategy of *skilful* questioning being used by the teacher. But what exactly is skilful questioning? I see it as that which addresses the needs of the immediate learning situation help learners progress to the kind of productive thought that is desired - understanding, problem solving, creative thinking, critical thinking, ethical thinking - these reflect the realities of high quality teaching and learning. However, skilful questioning is not a mechanistic process but one that requires the mental engagement of the teacher with the children's thinking as well as that of the children with the topic. This means that decisions have to be made in action but this does not mean that questioning is a totally on-the-spot matter. Forethought and planning can prepare the teacher for the interaction and ensure that there is a clear progression that focused questioning will support. A collection of prepared questions can be a useful resource. For those who lack confidence in the subject, a good book or scheme may help but these may be few and far between as far as focused questioning is concerned.

A final point is to do with the training of teachers to ask questions. Research shows that the effect of training teachers was significant, improving their questioning skills and outcomes in terms of gains in student achievement (Redfield & Rousseau, 1981; Gliessman *et al*, 1988). Interestingly, Redfield and Rousseau also showed that a mixture of lower and higher level questions was more effective in generating deeper understanding. Working in the USA, Lustick (2010) found that the questions used by teachers to foster reasoning are likely to be taken from a textbook, laboratory manual or a worksheet. As such, they are generic, not even class, let alone learner-specific. He recommends the use of more focused questions and emphasises the need for those delivering pre-service programmes for teachers to be *"... exposed to a more robust discussion about the quality of focus questions beyond that of higher or lower thinking and open or closed construction"* (2010: 508). He proposes a *focus question framework*

for teachers to use in science with pupils across the K-12 age range but emphasises the need for teachers to know more about the topic of questioning and develop the skills needed to exhibit focus questioning behaviours consistently. The consequence of such exposure would, according to Lustick:

> *"... translate into more engaging, interesting, and memorable learning experiences in future classrooms. By developing and incorporating science questions that promote sustained reasoning through inquiry, classroom teachers can help learners foster deeper understanding of science content and an appreciation for the scientific enterprise."*

Questioning can provide effective support for understanding and higher-level thinking. However, confining attention to one category of a taxonomy is not a helpful guide to the kinds of questions that make a difference to thinking. What matters more is that the question produces the kind of thinking that furthers the kind of learning that is wanted. What is needed is focused questioning that facilitates the development of children's knowledge and understanding as the basis for productive thought.

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